SETTING INSTREAM FLOW STANDARDS FOR RHODE ISLAND

Where are we and where do we go from here?

Background

- Rhode Island is generally considered a “water-rich” State, but we don’t always have the water where and when we need it
- Increased demands for water and concern over diminishing flows have brought about need to further refine instream flow policies, and permitting procedures
- Our research has encompassed reviews from many states around the country grappling with the same issues... How can we optimize use and availability for all needs? How much water is enough to support a healthy aquatic ecosystem?

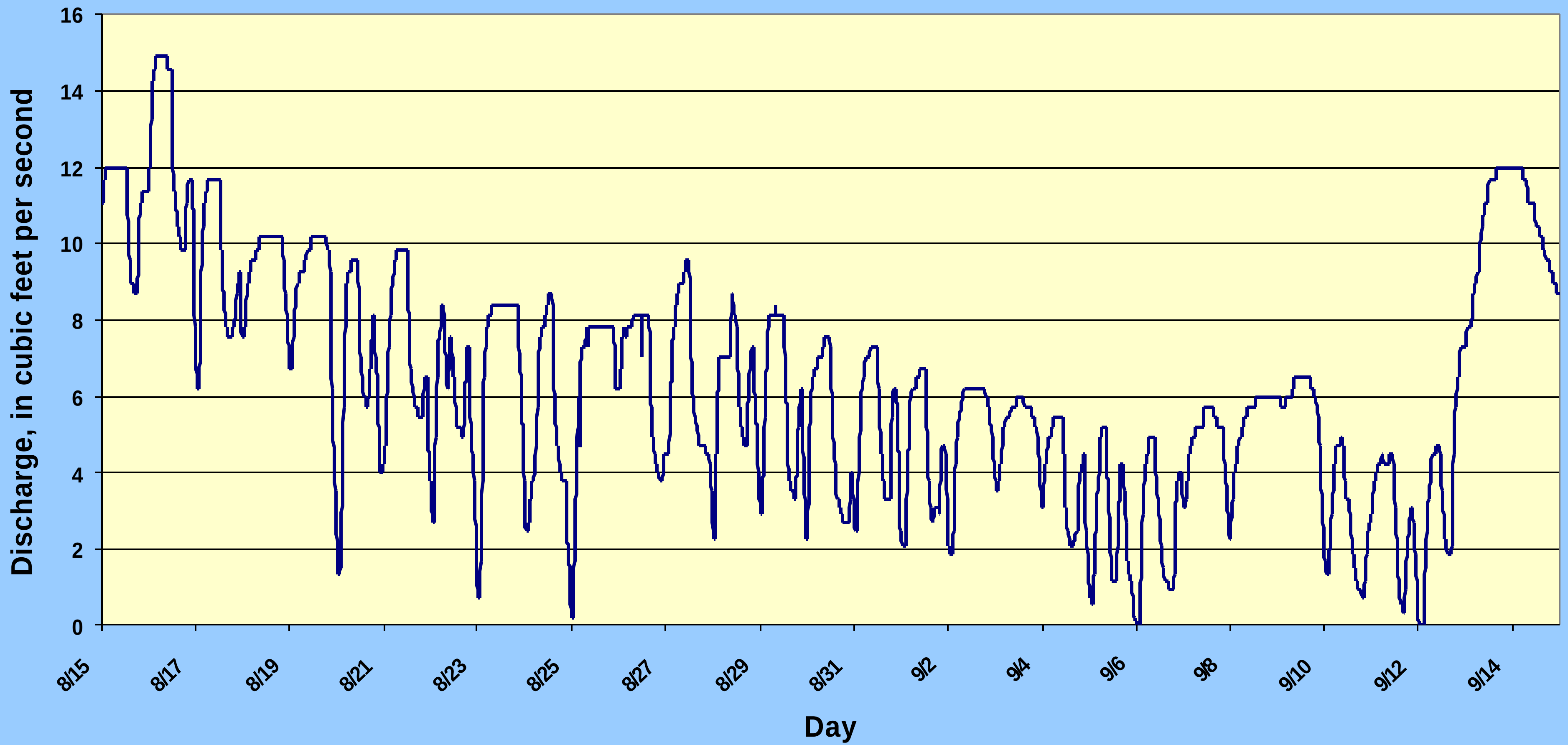
The Threat

The Ipswich River in Massachusetts is suffering from over-allocation and has dried up twice since 1995. Many other rivers across the US are suffering from this same condition.

The Threat to Rhode Island

- A recent draft USGS study "Assessment of Habitat, Fish Communities, and Streamflow Requirements for Habitat Protection, Usquepaug-Queen River" states that certain reaches "would appear to have little tolerance for additional temperature changes that could possibly be created by increased water withdrawals"
- USGS model for the Hunt-Annaquatucket basin shows 72% depletion of the stream @ 7Q10 flow conditions. Wild brook trout were found at all of the tributaries upstream of the wells; none were found downstream.
- A water budget computed by the USGS shows that nearly ½ of the water in the Chipuxet basin is annually pumped out of the watershed and exported to the Bay

Instantaneous streamflow at the Usquepaug River, at Rt. 2, near Usquepaug, RI (USGS station 01117420) during August 15 - September 15, 1995



Socio-economic implications of diminished stream flows

- The state’s rivers and lakes support an active and growing recreational boating & fishing, and tourism industry.
- In 1996, freshwater anglers spent $36 million on equipment and related expenses alone.
- Freshwaters are a component of state’s “natural capital” providing ecosystem services virtually free of charge (e.g. irrigation, flood storage) and representing potential avoided costs (e.g. higher wastewater treatment costs).

The Challenge

- To develop and implement a flow standard that allows for optimum use and encourages sound management practices while being protective of a healthy aquatic ecosystem
- To work with the Water Resources Board to incorporate a flow standard into a comprehensive water allocation policy

Guiding Principles for Establishing Instream Flow for the 2000's

- Remove "minimum flow concept" from in-stream flow management
- Planning activities will continue to require standard setting approaches, but must include inter- and intra- annual variability (think regimes)
- Management of annual flow regimes based on environmental accounts (allocations) will become more common and require real time monitoring and decision-making

In-stream Flow Council 2001

Five Ecosystem Components to be Addressed

- Hydrology (magnitude, frequency, duration, timing, rate of change)
- Geomorphology (channel process, sediment transport)
- Biology (habitat, living space, population relationships, sustenance and perpetuation of indigenous diverse aquatic fauna)
- Water Quality (temperature, dissolved oxygen, contaminants, etc)
- Connectivity (pathways for water, organisms, energy)

(*Instream Flow Council 2001)*

Types of Instream Flow Assessment Tools

Tool	Description	Examples
Baseline	Establishes environmental or reference conditions	RVA IBI, IHA
Standard-setting	Sets limits or rules to define a flow regime	Tennant ABF, Wetted Perimeter R2-Cross
Incremental	Analyzes single or multiple variables to enable assessment of different flow management alternatives	IFIM, PHABSIM RCHARC, SNTEMP Demonstration Flow Assessment
Monitoring / Diagnostic	Assesses conditions and how they change over time	IBI, HQI, IHA

(Instream Flow Council 2001)

Two Ways of Setting Flow Targets (Stalnaker, 1995)

Standard Setting

- Low controversy project
- Reconnaissance-level planning
- Few decision variables
- Inexpensive
- Fast
- Rule-of-thumb
- Less scientifically accepted
- Not well-suited for bargaining

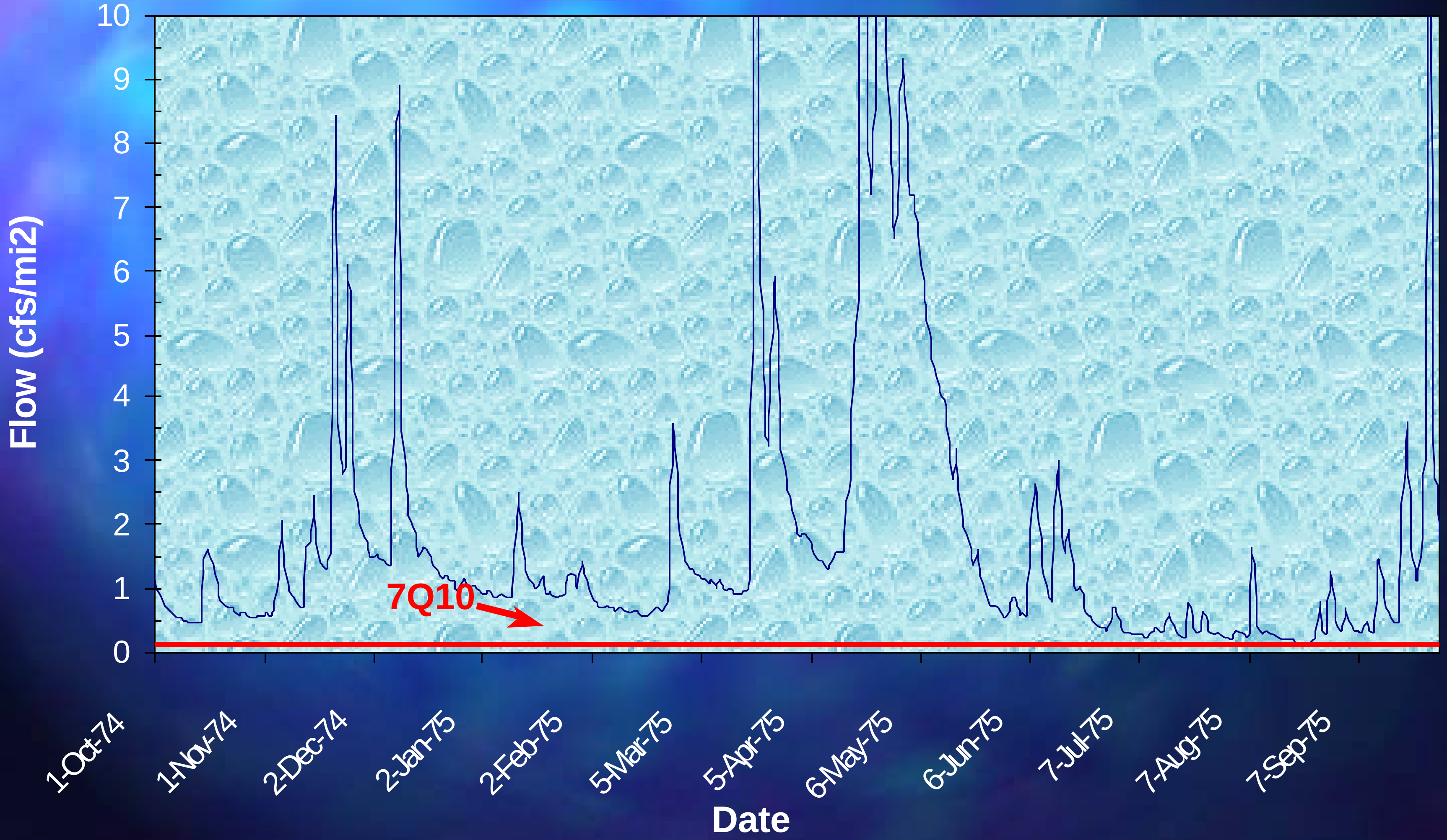
Incremental

- High controversy project
- Project-specific
- Many decision variables
- Expensive
- Lengthy
- In-depth knowledge required
- More scientifically accepted
- Designed for bargaining
- Based on fish or habitat

7Q10

- Statistical term representing the average annual seven day minimum flow with a recurrence interval of 10 years
- Used as a low flow for establishing permit limits for waste treatment plants
- As a base flow standard, 7Q10 flow is not protective of aquatic life and does not consider seasonal variations; severe degradation is likely

Mad River Daily Flow Hydrograph
Water Year 1975

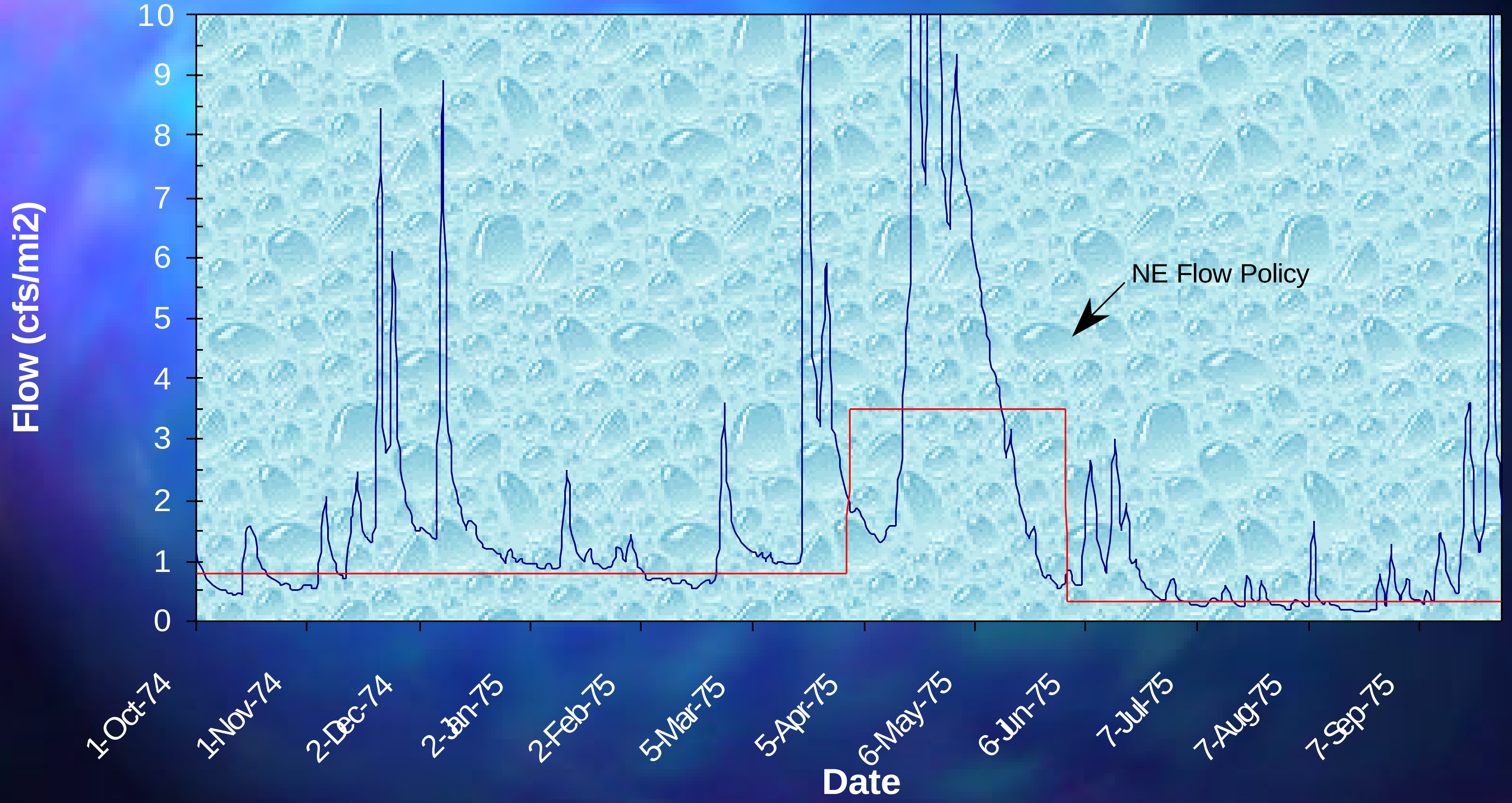


New England Aquatic Base Flow (ABF) Method

- The summertime ABF streamflow recommendations for free-flowing streams (unaltered by withdrawals) are determined from the streamflow equal to the median monthly-mean flow for August.
- For ungaged or regulated rivers, the ABF streamflow recommendation is determined by the following default flows:

Season (months)	Period	Streamflow
Summer(mid-Jun to mid-Oct)	**Low flow**	**0.5 $(ft^3/s)/mi^2$**
Fall/Winter(mid Oct to Mar)	**Spawning and incubation**	**1.0 $(ft^3/s)/mi^2$**
Spring(Apr-mid Jun)	**Spawning and incubation**	**4.0 $(ft^3/s)/mi^2$**

Mad River Daily Flow Hydrograph
Water Year 1975



New England Aquatic Base Flow

PROS

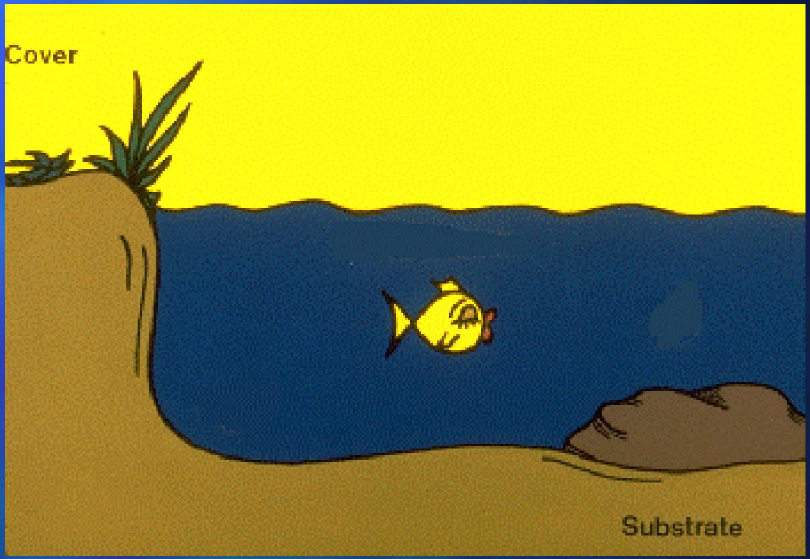
- Used by USF&W on FERC and Army Corps permits
- Incorporates temperature
- Has been successfully defended in court
- Has a default flow for small streams
- Has seasonal considerations

CONS

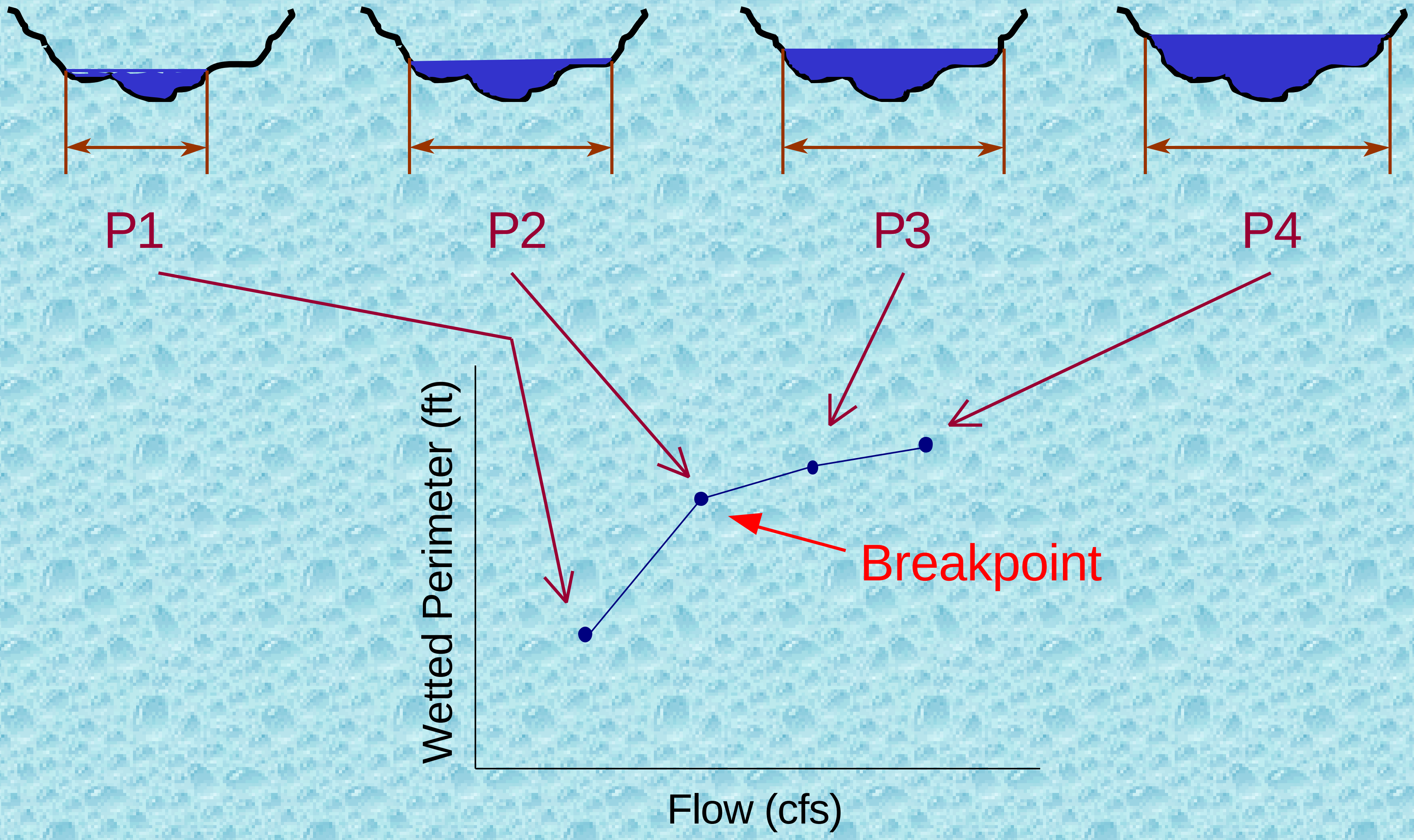
- Primarily designed for flow releases
- For large streams (>50 mi^{2}), a long term record of stream flow unaltered by withdrawals is required
- Spring Default value is difficult to attain naturally in SE New England due to lack of significant snow melt
- Difficult to apply to consumptive uses because flow is not naturally met for 1/2 of August and 1/2 of September

Wetted Perimeter

This method assumes that the carrying capacity of the stream is proportional to fish-food producing areas and that wetted perimeter in riffles is an index of this relation. Calculations are required to determine the flow that maintains the riffle and fills the "toe of the bank"



Wetted Perimeter Method



(Stalnaker et al. 1995)

Wetted Perimeter Method

PROS

- Gaged stream flow data not needed to apply this method
- Site-specific habitat assessment
- Theories and science are well accepted

CONS

- The “toe of the bank” is subject to interpretation
- Moderately intensive field work required
- Does not consider temperature
- May not provide adequate depth over riffles

Tennant Method

The Tennant Method bases its streamflow requirements on the observation that aquatic habitat conditions are similar in streams carrying the same portion of mean annual flow. Minimum streamflows are considered to be the 40-, 30-, and 10- percent of the mean annual flow which represents good, fair, and poor habitat conditions. Canadian Atlantic Provinces have adapted 25 percent to represent fair habitat conditions.

Tennant Method

PROS

- Simple to apply when you have pre-requisite stream flow data
- Works for all stream sizes
- Has a seasonal component

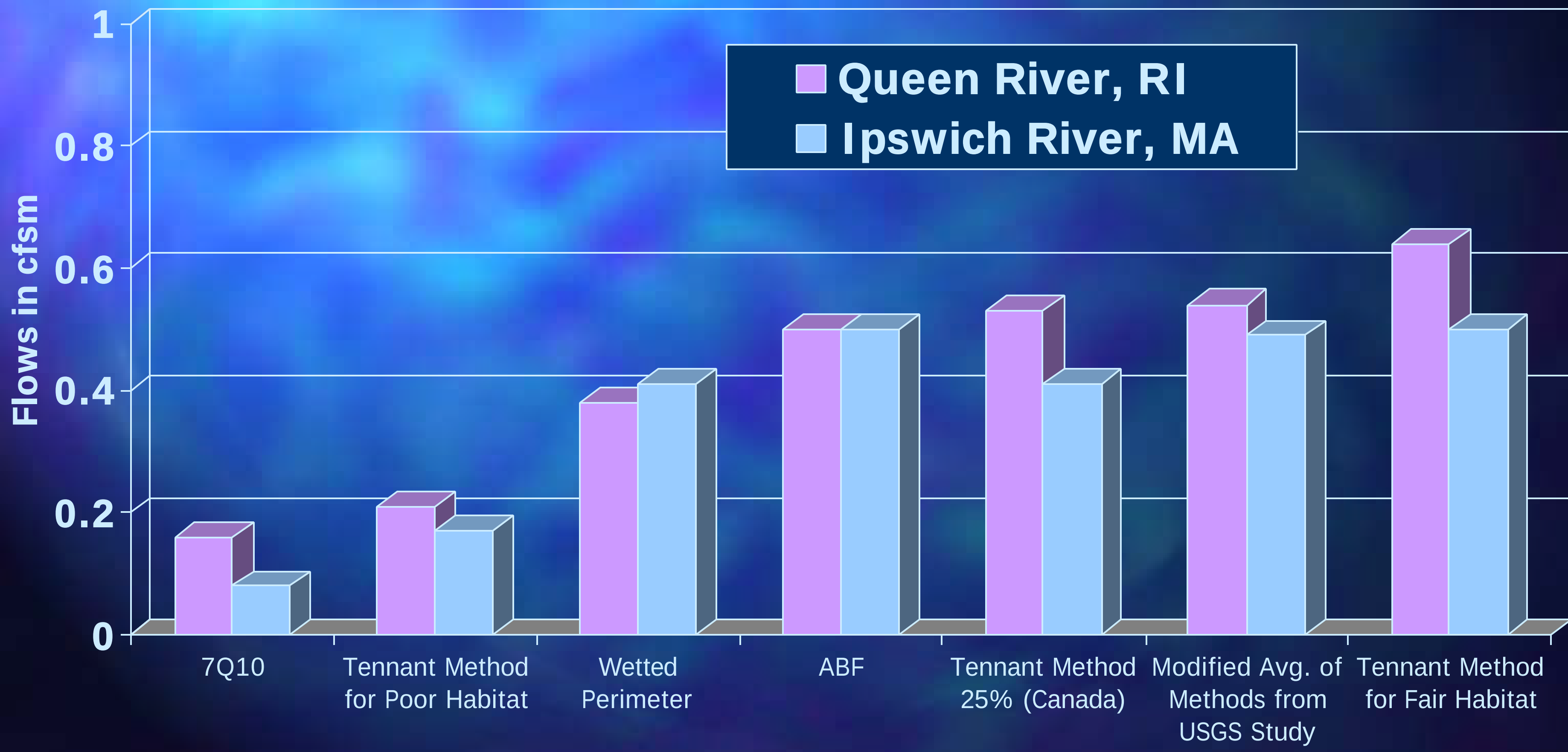
CONS

- Needs $\geq$ 30 years record of stream flow unaltered by withdrawals
- Influenced by current diversions
- Developed in west, certain assumptions not applicable to east

R2Cross Method

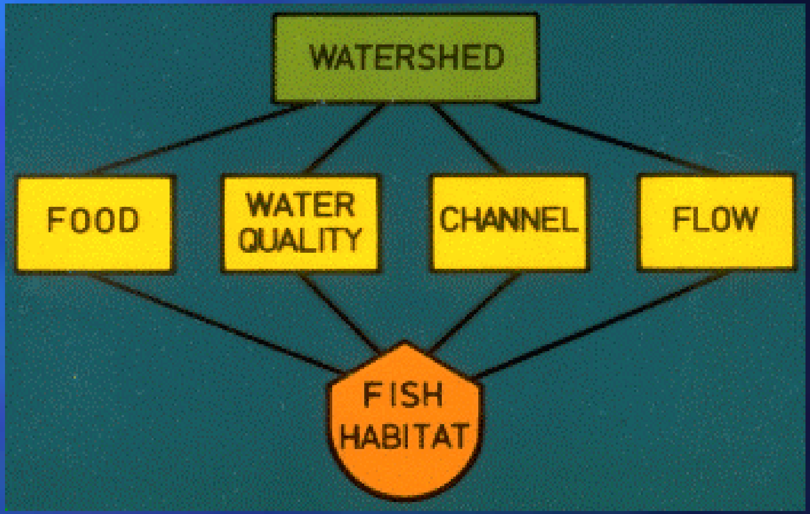
The R2Cross method requires selection of critical area of the stream, a riffle, and assumes that a discharge chosen to maintain habitat in the riffle is sufficient to maintain fish habitat in the entire stream. Maintaining a riffle includes meeting criteria for 3 parameters which change based upon stream width. They are: mean depth, bank-full wetted perimeter (%) and average velocity

How do the methods compare?



In-stream Flow Incremental Methodology (IFIM)

The methodology is designed to consider each topic listed to the right and in turn, force a decision as to the importance of that topic or variable to the resource being managed and then determine the flow needed by the limiting factor. IFIM is a problem solving methodology utilizing a general problem-solving approach employing systems analysis techniques.



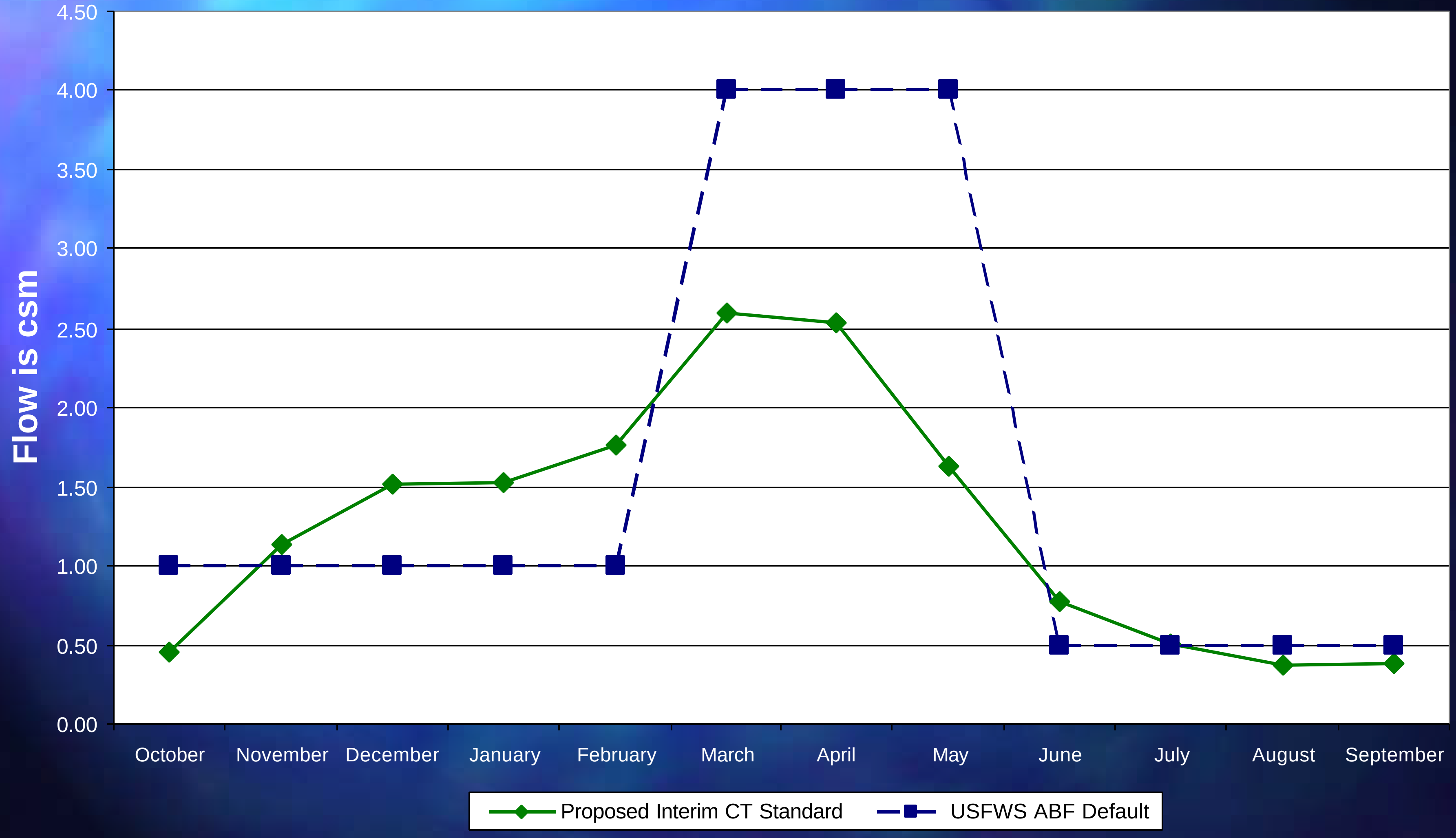
Indicators of Hydraulic Alteration (IHA)

A method for assessing the degree of hydraulic alteration attributable to human influence within an ecosystem. The method uses 32 statistical analyses to look at pre- and post- dam construction or groundwater withdrawal to determine if the river systems have been altered.

Proposed Connecticut Method (Apse, 2000)

- Selected 10 Connecticut rivers which are wholly unaltered by withdrawals or slightly altered
- At least 30 years of record
- Watershed areas between 4.1 and 203 mi^2
- Calculate monthly numbers using FWS approach (median of monthly means) for July-September, other months uses median of daily means

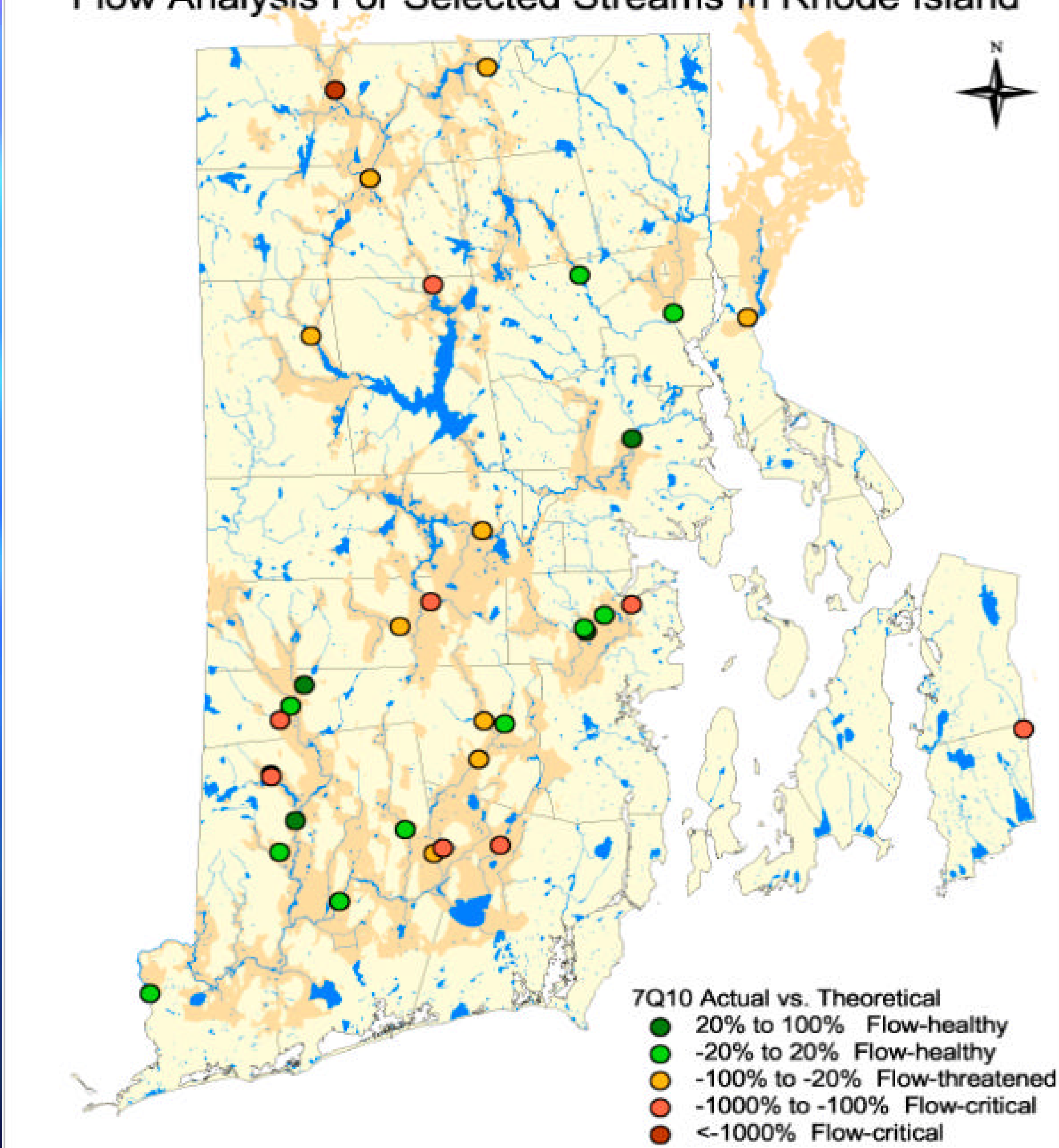
Figure 6: Proposed Connecticut Interim Instream Flow Standard vs. USFWS New England Aquatic Base Flow Standard

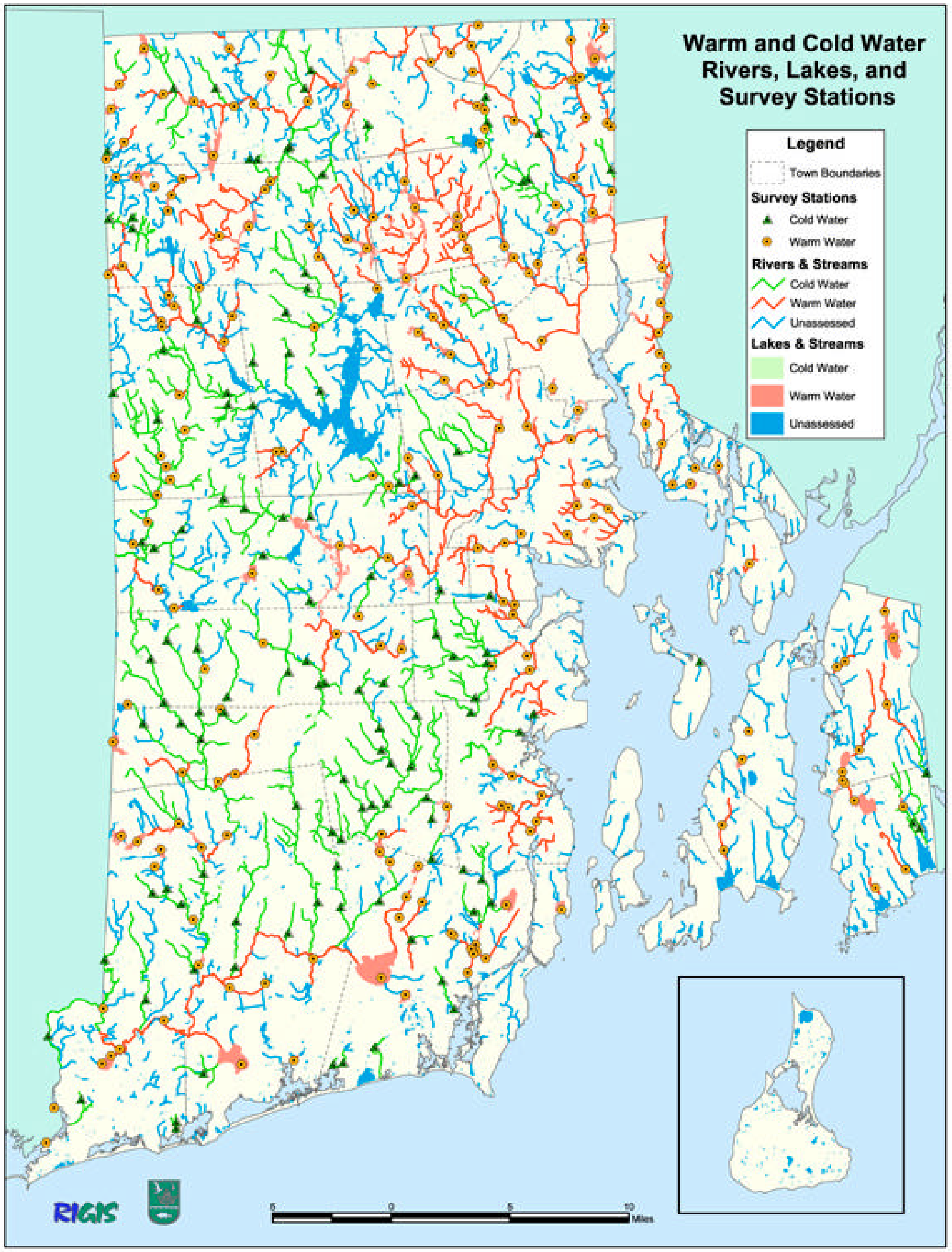


Office of Water Resources' efforts to date

- Researched other states' policies and application procedures
- Developed a method to identify flow stressed rivers based on hydraulic characteristics
- Developing a draft guidance document for application submittals (including preliminary screening process)
- In coordination with F&W, created preliminary map of coldwater fisheries (wild brook trout)

Flow Analysis For Selected Streams In Rhode Island





Warm and Cold Water Rivers, Lakes, and Survey Stations
Legend
Town Boundaries
Survey Stations
Cold Water
Warm Water
Rivers & Streams
Cold Water
Warm Water
Unassessed
Lakes & Streams
Cold Water
Warm Water
Unassessed
RIGIS
5
0
5
10
Miles

Interim Permitting Measures under Consideration

- Apply seasonal ABF instream flow targets – possibly adopting CT approach (monthly mean stream flows) for RI.
- Allow applicants to perform more detailed site specific studies, if desired
- Encourage/require efficient water use and recharge/retention as conditions in a permit.
- Establish trigger flows for water management actions.
- Establish additional conditions to be protective of cold water fisheries
- Allow De Minimis withdrawals (once registration process is in place and cumulative uses are identified)

How could an instream flow standard be applied?

1. To determine availability of water for future allocation and set management goals
2. To serve as the instream flow condition in hydrologic and WQ modeling (rather than 7Q10)
3. To establish “triggers” for water conservation actions, including potentially triggers for “shutoff” of hydraulically connected withdrawals.
4. To establish conditions in regulatory decisions
5. To establish environmental measure for inclusion in holistic water management strategy that encourages conservation, recharge, trading, banking, reuse, etc.

Challenges in Developing an Instream Flow Standard

- Limited stream flow gage data
- Most gaged sites are heavily influenced by withdrawals, therefore historic flow data may not be supportive of healthy habitat.

Challenges for Implementing an Instream Flow Policy

- Water users (especially public water suppliers and ag producers) require/desire certainty that adequate quantities of water will be available to them as needed
- To ensure protection of the aquatic resources, there will be times when further stream depletions must cease. Users need alternate sources or to have ability to cease withdrawals.

Challenges for Implementing an Instream Flow Policy (continued)

- Streams naturally fall below ABF levels – habitat is able to recover from natural variation. How much additional stress (from anthropogenic influences) can a stream withstand? In other words, what duration and frequency of low flow conditions are acceptable?
- In stressed basins, to fully optimize uses and protect aquatic resources, watershed specific studies and water resource management plans are needed. This will require time, money and technical resources.

Inter-relationships between instream flow and water allocation policies

- Existing permitting programs represent first come first serve approach - this may not be consistent with public goals that might be established under an allocation policy
- Data from registered users allows for determination of aggregate use for each reach within a watershed
- Once instream flow standard is set, evaluation of aggregate use data along with stream flow data allows for determination of quantity of water available for new uses

Next steps in establishing in-stream flow standard

- Investigate validity of CT approach of establishing monthly ABF to RI rivers
- Use Queen-Usquepaug HSPF model to evaluate relationship between withdrawals, flow, and habitat availability, and secondly, evaluate water resource management alternatives on stream flow